# DRAFT
# TMDL for Dissolved Oxygen for Violet Canal (Subsegment 041805) in the Lake Pontchartrain Basin, Louisiana

Prepared for:

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# Executive Summary

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] section 130.7) require TMDLs for waterbody-pollutant pairs on the approved 303(d) impaired waters list, even if pollutant sources have implemented technology-based controls. A total maximum daily load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can assimilate while still meeting the water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality, and it may include a future growth (FG) component. The components of the TMDL calculation are illustrated using the following equation:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS + FG$$

The area for this TMDL includes Lake Borgne Canal, from Mississippi River siphon at Violet to Bayou Dupre, also called Violet Canal. Violet Canal is located entirely within St. Bernard Parish and covers an area of 0.362 square miles (0.937 square kilometers). Violet Canal runs from the Mississippi River in the west to Bayou Dupre, where it is connected to Lake Borge, in the east. The predominant land use in the impaired subsegment is wetlands (72.8 percent), followed by urban development (19 percent), and open water (8.2 percent).

The Louisiana Department of Environmental Quality (LDEQ) has included Violet Canal (subsegment 041805) on the state's 2010 section 303(d) list of impaired waterbodies (*Draft 2010 Integrated Report*) (LDEQ 2010a) (Table ES-1). The subsegment is listed for low dissolved oxygen (DO) and turbidity. Turbidity is not addressed in this report. The impaired designated uses for the subsegment are fish and wildlife propagation (FWP) and outstanding natural resource (ONR).

**Table ES-1. Excerpt from *Draft 2010 Integrated Report***

| Subsegment | Subsegment name | Designated use | | | |
|---|---|---|---|---|---|
| | | Primary Contact Recreation | Secondary Contact Recreation | Fish and Wildlife Propagation | Outstanding Natural Resource |
| 041805 | Violet Canal | Fully supporting | Fully supporting | Not supporting | Not supporting |

Source: LDEQ 2010a

A water quality model (LA-QUAL) was set up to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and nitrite+nitrate. The model was calibrated using data from fieldwork conducted in July 2009. The projection simulation was conducted at critical flows and temperatures to address seasonality, as the Clean Water Act requires. No reductions of existing point source loads were required for the projection simulation to meet the DO standard of 4 milligrams per liter (mg/L). In general, the modeling for this TMDL was consistent with guidance in the Louisiana TMDL technical procedures manual (LDEQ 2010b).

TMDLs for CBOD, ammonia, organic nitrogen, and sediment oxygen demand (SOD) were calculated using the projection simulation. In developing the TMDL, allowable loads from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls. WLAs were assigned to permitted point source discharges, including regulated stormwater. The LAs include background loadings and human-induced nonpoint sources. An explicit MOS of 10 percent and an FG component of 10 percent were also included.

This TMDL establishes load limitations for oxygen-demanding substances. The numeric DO water quality criterion for subsegment 041805 is 4 mg/L and was used to calculate the total allowable load in summer and winter scenarios. There were no reductions to point sources. Table ES-2 presents a summary of the TMDLs for subsegment 041805.

**Table ES-2. Summary of TMDLs, WLAs, LAs, MOSs, and FGs**

| Season | Loadings (lb/d) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Summer | SOD | | $CBOD_u$ | | Ammonia as N | | Organic N as N | |
| | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL |
| WLA | 177.2 | 126.5 | 4.18 | 2.67 | 0.174 | 0.174 | 0.240 | 0.240 |
| LA | 736.2 | 525.8 | 12.68 | 6.38 | 0.043 | 0.043 | 0.658 | 0.658 |
| MOS | 114.2 | 81.5 | 2.11 | 1.13 | 0.027 | 0.027 | 0.112 | 0.112 |
| FG | 114.2 | 81.5 | 2.11 | 1.13 | 0.027 | 0.027 | 0.112 | 0.112 |
| TMDL | 1,141.6 | 815.5 | 21.08 | 11.30 | 0.272 | 0.272 | 1.122 | 1.122 |
| Percent reduction | 28.6% | | 46.4% | | 0.0% | | 0.0% | |
| Season | Loadings (lb/d) | | | | | | | |
| Winter | SOD | | $CBOD_u$ | | Ammonia as N | | Organic N as N | |
| | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL |
| WLA | 92.0 | 92.0 | 32.04 | 32.04 | 0.32 | 0.32 | 1.69 | 1.69 |
| LA | 382.2 | 382.2 | 128.43 | 128.43 | 0.67 | 0.67 | 6.70 | 6.70 |
| MOS | 59.3 | 59.3 | 20.06 | 20.06 | 0.12 | 0.12 | 1.05 | 1.05 |
| FG | 59.3 | 59.3 | 20.06 | 20.06 | 0.12 | 0.12 | 1.05 | 1.05 |
| TMDL | 592.6 | 592.6 | 200.58 | 200.58 | 1.24 | 1.24 | 10.49 | 10.49 |
| Percent reduction | 0.0% | | 0.0% | | 0.0% | | 0.0% | |

Implementing the DO TMDL through future wastewater discharge permits, if required, and implementing best management practices to control and reduce runoff of soil and oxygen-demanding pollutants from nonpoint sources in the watershed should reduce the nutrient loading from those sources.

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# 1. Introduction

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] section 130.7) require TMDLs for waterbody-pollutant pairs on the approved 303(d) impaired waters list even if pollutant sources have implemented technology-based controls. A total maximum daily load (TMDL) is a calculation of the maximum allowable load (in mass per unit time) of a pollutant that a waterbody is able to assimilate while still supporting its designated uses. The maximum allowable load is determined on the basis of the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

The text of 40 CFR 130.7 has been affected by several Federal District Court suits, appeals rulings, and a Supreme Court ruling, mandating that a TMDL must be described in terms of mass per day. According to 40 CFR 130.7, if EPA does not approve a TMDL submitted by a state, EPA is responsible for developing a TMDL. In a District Court case regarding the TMDL program in Louisiana (*Sierra Club and Louisiana Environmental Action Network, Inc. v. EPA*, Civil Action Number: 96-0527), EPA was listed as the sole defendant. That case resulted in the April 1, 2002, consent decree approved by the judge. A consent decree is a negotiated set of actions to satisfy the plaintiff. In many situations, the actions are more stringent than the established regulation. For example, most consent decrees require an annual report to the plaintiff summarizing the work done in the year; that is not required by any regulation and will cease when the consent decree is closed.

The 2002 consent decree between EPA and the plaintiffs establishes a fixed set of waterbody-pollutant pairs for which TMDLs are to be established or approved, and it establishes a timeline for each set of TMDLs. Each set is determined to be complete when every waterbody-pollutant pair either has a TMDL established or approved, or a subsequent approved 303(d) list has removed the waterbody-pollutant pair. The TMDLs in this report are part of that consent decree. Because the original court suit was initiated because of a lack of progress in establishing TMDLs, the date when a TMDL is established or approved is not easy to extend and requires another agreement with the plaintiffs.

In most circumstances, a variety of scientifically acceptable methods can be used for developing a TMDL, wasteload allocation (WLA), and load allocation (LA). For these TMDLs, the LA-QUAL model was used. It should be noted that because some acceptable TMDL calculation methods appear simple, that does not imply that its results are not valid. Models vary in the amount of necessary resources (e.g. training, setup/computational time, personnel, expense), required input and background data, questions answered, and output capability (e.g., charts, tables, data files). The final result of these TMDLs (and any TMDL) is a plan that is adopted into the Water Quality Management Plan (WQMP) to achieve the TMDL. Stakeholder involvement and additional information, such as monitoring data, might lead to an update of the WQMP to propose a different plan to meet water quality objectives. Such a WQMP update receives the same public participation as the original TMDL and WQMP review and approval.

For the TMDL discussed in this report, monitoring data collected by the Louisiana Department of Environmental Quality (LDEQ) indicate that observed dissolved oxygen (DO) levels sometimes do not meet the state's water quality criteria for Violet Canal (subsegment 041805) in the Lake Pontchartrain Basin. The impaired designated uses for the subsegment are primary and secondary contact recreation and fish and wildlife propagation. The subsegment is listed as not supporting the designated uses in Louisiana's 2010 section 303(d) list (as included in the *Draft 2010 Integrated Report*). Subsegment 041805 has suspected causes for the DO impairment of *natural sources and package plant or other permitted small flow discharges*. The suspected causes for the turbidity impairment are *natural sources and changes in tidal circulation/flushing*. Turbidity is not addressed in this TMDL report.

Oxygen concentrations in bodies of water fluctuate naturally; however, depletion of DO can be caused by human activities or natural sources. Temperature and salinity also have an effect on DO. For example, during extended hot weather, the subsequent warmer water can result in fish kills from lower DO in the water column because of decreased gas solubility compared to cooler water (Scorecard 2005). Chemical reactions can generate a chemical oxygen demand on receiving waters and further lower DO. Human activities, such as lawn mowing and fertilizing, can contribute large amounts of biodegradable organic matter or nutrients through stormwater and, over time, lead to eutrophication (Scorecard 2005). Natural sources can also add organic material to a waterbody. Forests add leaves and woody debris, whereas wetlands have large algal masses that can be carried over into the waterbody. In streams with significant amounts of organic matter, bacterial degradation can result in a net reduction of oxygen in the water column.

Other factors that affect DO concentrations include the following (Murphy 2005):

- Volume and velocity of water flowing in the waterbody
- Climate and season
- The type and number of organisms in the waterbody
- Altitude
- Dissolved or suspended solids
- Amount of nutrients in the water
- Organic waste
- Riparian vegetation
- Groundwater inflow

# 2. Background Information

## 2.1 General Description

The Lake Pontchartrain Basin is in southeastern Louisiana and is primarily comprised of the rivers and bayous that drain into Lake Pontchartrain. The basin is bordered by the Pearl River Basin to the east, by Breton and Chandeleur Sound to the southeast, and by the Mississippi River Levee to the south and west. The northern portion of the Lake Pontchartrain Basin consists of forests, pines and hardwoods, pastures, and dairies. The southern portion consists of cypress-tupelo swamps and lowlands, and brackish and saline marshes. Elevations in the basin range from minus 5 feet at New Orleans to greater than 200 feet near the Mississippi River (LDEQ 2010c). Subsegment 041805 (Lake Borgne Canal from Mississippi River siphon at Violet to Bayou Dupre; also called Violet Canal) is located entirely in St. Bernard Parish and has an area of 0.362 square miles ($mi^2$)(232 acres). Violet Canal runs from the Mississippi River in the west to Bayou Dupre, where it is connected to Lake Borge in the east.

## 2.2 Land Use

Land use data were obtained from the 2006 U.S. Geological Survey (USGS) National Land Cover Dataset (NLCD) (Table 2-1 and Figure 2-2). The predominant land use in subsegment 041805 is wetlands (72.8 percent), followed by urban development (19 percent), and open water (8.2 percent).

**Table 2-1. Land uses percentages for subsegment 041805**

| Land use | Percent of total area |
|---|---|
| Water | 8.2% |
| Developed | 19.0% |
| Barren | 0% |
| Forest | 0% |
| Grassland/shrub | 0% |
| Pasture/hay | 0% |
| Cultivated crops | 0.9% |
| Wetlands | 72.8% |
| TOTAL | 100.00% |

## 2.3 Hydrologic Setting

The USGS online hydrology database (NWISWeb) does not contain any stations with flow data for subsegment 041805 that is impaired for DO. Gated structures exist where Violet Canal meets the Mississippi River Gulf Outlet and are operated to prevent high Gulf tides from reaching the area. Otherwise, Violet Canal is affected by tidal action from Lake Borgne (Max Forbes, LDEQ, personal communication, May 31, 2011).

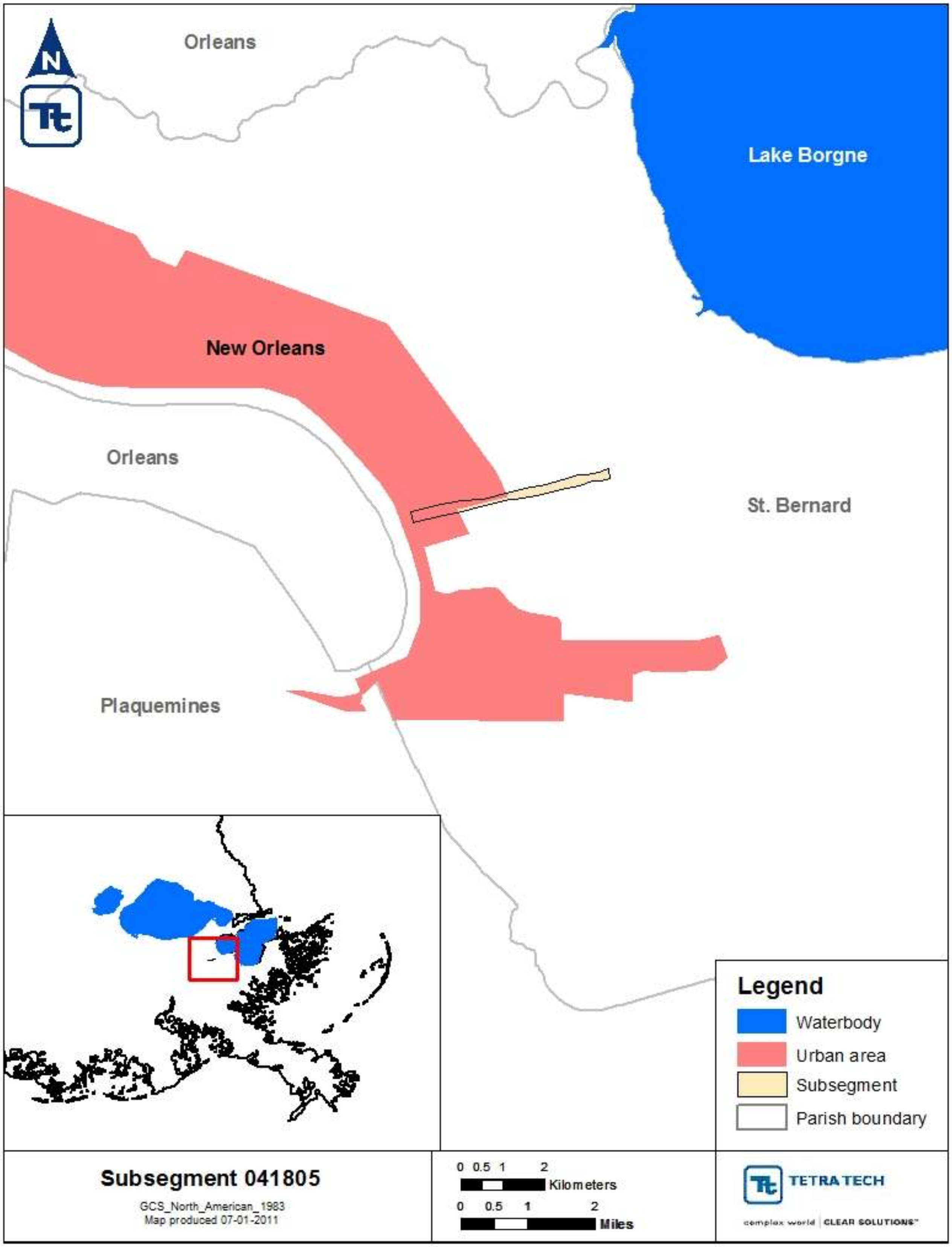


**Figure 2-1. Location of subsegment 041805.**

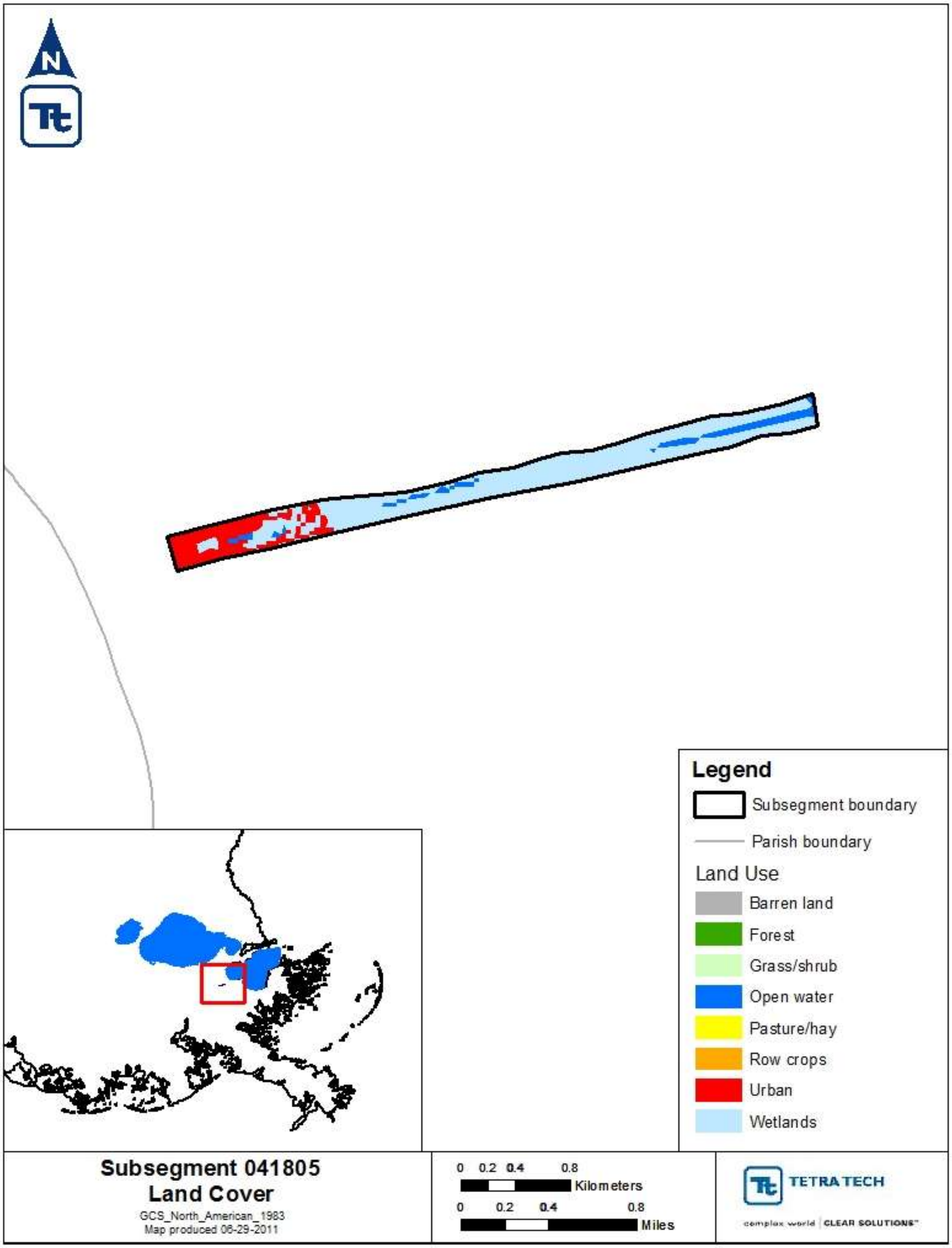


Figure 2-2. Land use in subsegment 041805.

## 2.4 Designated Uses and Water Quality Criteria

Louisiana's 2010 section 303(d) list (as included in the *Draft 2010 Integrated Report*) indicates that designated uses of the subsegment are primary and secondary contact recreation, fish and wildlife propagation, and outstanding natural resources. Primary contact recreation includes any recreational or other water contact involving full-body exposure to water and a considerable probability of ingesting water. Examples of this use are swimming and water skiing. Secondary contact recreation involves activities like fishing, wading, or boating, where water contact is accidental or incidental and there is a minimal chance of ingesting appreciable amounts of water. Fish and wildlife propagation includes the use of water for aquatic habitat, food, resting, reproduction, cover, or travel corridors for any indigenous wildlife and aquatic life species associated with the aquatic environment. Outstanding natural resource waters include waterbodies designated for preservation, protection, reclamation, or enhancement of wilderness, aesthetic qualities, and ecological regimes, such as those designated under the Louisiana Natural and Scenic Rivers System or those designated by LDEQ as waters of ecological significance. Characteristics of outstanding natural resource waters include, but are not limited to, highly diverse or unique in-stream and/or riparian habitat, high species diversity, balanced trophic structure, unique species, or similar qualities.

The assessment methodology presented in LDEQ's 305(b) report (LDEQ 2010a) specifies that primary contact recreation, secondary contact recreation, fish and wildlife propagation, and outstanding natural resource uses are to be fully supported. Subsegment 041805 is an estuarine system. The DO criterion for this subsegment is 4 milligrams per liter (mg/L) year-round.

The Louisiana water quality standards also include an antidegradation policy (*Louisiana Administrative Code* [LAC] Title 33, Part IX, Section 1109.A), which states that state waters exhibiting high water quality should be maintained at that high level of water quality. If that is not possible, water quality of a level that supports the designated uses of the waterbody should be maintained. The designated uses of a waterbody may be changed to allow a lower level of water quality only through a use attainability study.

## 2.5 Identification of Sources

### 2.5.1 Point Sources

LDEQ stores permit information using internal databases. LDEQ generated a list of point source discharges in the subsegment by using the TEMPO database. Information on point source discharges to the listed subsegments was obtained from the Integrated Compliance Information System - National Pollutant Discharge Elimination System (ICIS-NPDES) and Louisiana's Electronic Document Management System (EDMS). Data were pulled from ICIS for the list of permits generated by LDEQ and data were confirmed through EDMS. Each facility was evaluated on the basis of its discharges and permit limits to determine whether the facility should be used in developing the TMDLs. The evaluation yielded one active permitted point source discharge in subsegment 041805 (Table 2-2 and Figure 2-3).

**Table 2-2. Permit information for subsegment 041805**

| Agency interest (AI) # | Permit # | Outfall | Outfall type | Facility name | Facility type | Expiration date | Receiving waterbody |
|---|---|---|---|---|---|---|---|
| 20849 | LAG531277 | 001 | Treated sanitary wastewater | Violet Chevron | Auto dealers and gasoline service stations | 11/30/12 | via pipe to Violet Canal |
| 52457 | LAU009473 | | | Val J Dauterive & Son Inc. - Petroleum Bulk Plant | Petroleum Refining And Related Industries | Terminated | |

Phase I and II stormwater systems are additional possible point source contributors in the Lake Pontchartrain Basin. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. Most stormwater discharges are considered point sources and require coverage by a NPDES permit.

Under the NPDES stormwater program, operators of large, medium, and regulated small municipal separate storm sewer systems (MS4s) must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 *Federal Register* 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population between 100,000 and 249,999; a large MS4 has a population of 250,000 or more.

Phase II requires a select subset of small MS4s to obtain an NPDES stormwater permit. A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II rule automatically covers all small MS4s in urbanized areas (UAs), as defined by the Bureau of the Census, and also includes small MS4s outside an UA that are so designated by NPDES permitting authorities, case by case (USEPA 2000).

In Louisiana, there are two ways that an MS4 can be identified as a regulated, small MS4. This category includes all cities within UAs and any small MS4 area outside UAs with a population of at least 10,000 and a population density of at least 1,000 people per square mile (LDEQ 2002). In subsegment 041805, there is one Phase II (small) MS4. Table 2-3 presents MS4 discharge information for this impaired subsegment in the Lake Pontchartrain Basin. The urban area of the MS4 covers 45 acres of subsegment 041805.

**Table 2-3. MS4 information for subsegment 041805**

| Agency interest (AI) # | Permit # | Facility name | Expiration date | Receiving waterbodies |
|---|---|---|---|---|
| 108277 | LAR040003 | St Bernard Parish Government - Municipal Separate Storm Sewer System | 12/4/12 | Violet Canal |

### 2.5.2 Nonpoint Sources

Louisiana's section 303(d) list identifies the suspected causes of the DO impairment in subsegment 041805 of the Lake Pontchartrain Basin as *natural sources and package plant or other permitted small flow discharges.*

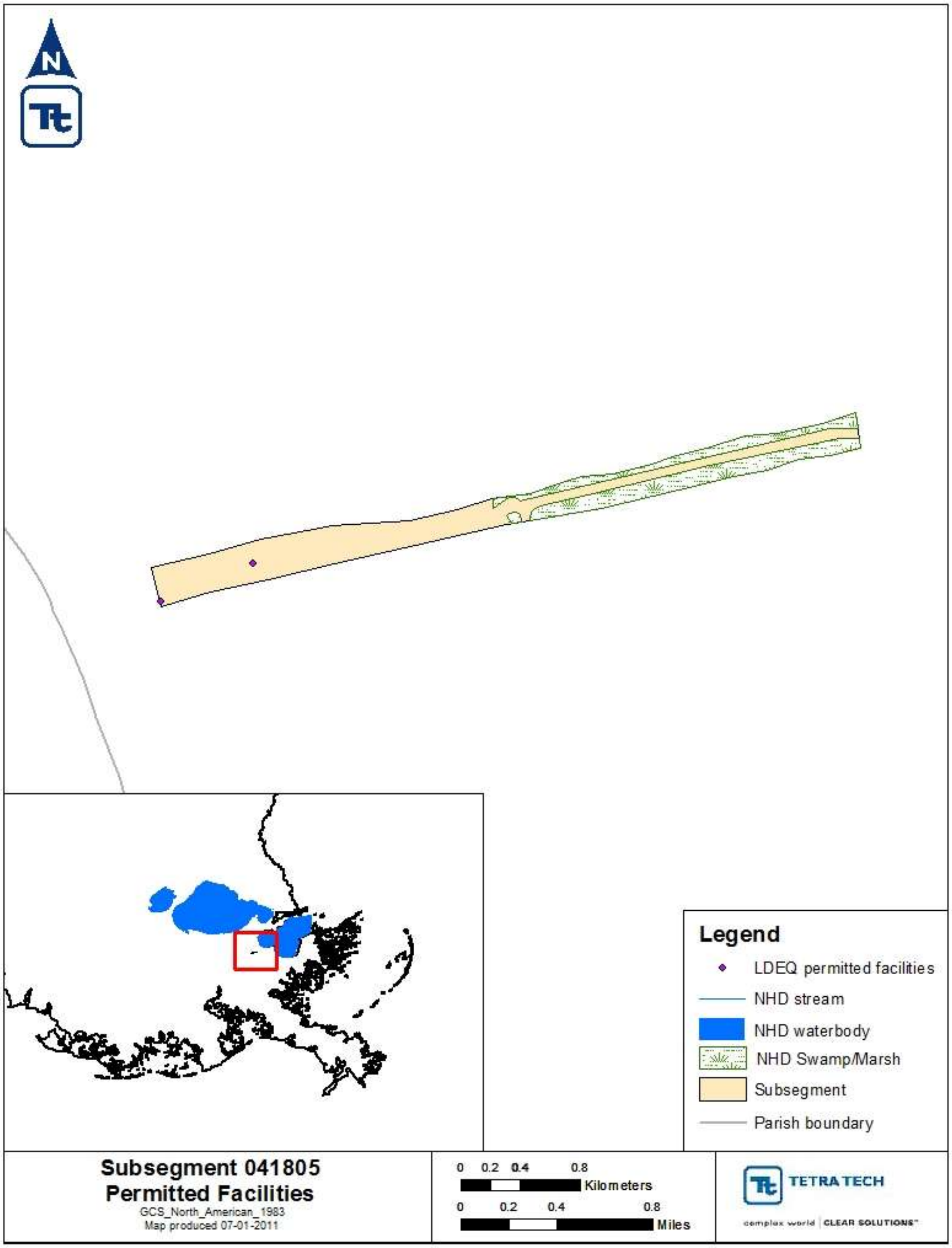


**Figure 2-3. Permitted Facilities in subsegment 041805 in the Lake Pontchartrain Basin.**

# 3. Characterization of Existing Water Quality

## 3.1 Water Quality Data

Water quality data were obtained from LDEQ's routine ambient water quality monitoring program. Additional environmental data were obtained from a monitoring event conducted by FTN Associates (FTN) on July 9, 2009. Figure 3-1 shows the locations of the LDEQ and FTN sampling sites. Data collected during the 2009 field study included in situ measurements of temperature, DO, pH, specific conductivity, and Secchi depth in addition to sampling data for total phosphorus (TP), ortho-phosphorus (OP), chlorophyll *a*, total suspended solids (TSS), ammonia nitrogen, total Kjeldahl nitrogen (TKN), nitrate plus nitrite nitrogen ($NO_2$+$NO_3$), total organic carbon (TOC), and carbonaceous biochemical oxygen demand (CBOD) time series, which used a nitrogen suppressant. The CBOD time-series data were collected on days 2, 5, 9, 14, 20, and 27 of the analysis. Tables A-1 through A-7 in Appendix A summarize the water quality data for the section 303(d)-listed constituents, along with additional constituents used in the TMDL development process. Appendix A contains summaries of the DO and nutrient data. Appendix B presents the Field Survey Notes.

## 3.2 Comparison of Observed Data to Criteria

Table A-1 in Appendix A provides a summary of the July 2009 DO data for five stations (plus a duplicate station) in subsegment 041805. Each station has one observation taken on July 9, 2009. DO was not observed in any of the five stations at levels below the water quality criterion of 4 mg/L. Figures A-1 through A-4 in Appendix A show the LDEQ DO and other continuous monitoring data observations at station VIOLET-3 (Violet Canal) over time.

Table A-4 summarizes 23 observations at the LDEQ DO data at station 1068 (Violet Canal near New Canal). Eight (35 percent) of the DO observations are below the 4 mg/L water quality criterion. Figures 3-2 and 3-3 show the DO data collected at station 1068 plotted over time and season. As expected, DO levels are lower in the hotter summer months.

Louisiana does not have numeric nutrient criteria. The original nutrient impairment for this waterbody was not based on a quantitative assessment of historical nutrient data. The impairment was based on an evaluative assessment that might have included dissolved oxygen. LDEQ and EPA plan to reevaluate the previous nutrient impairments for this waterbody. As a result, both EPA and LDEQ expect the nutrient impairment to change from category 5 (impairment exists; TMDL required) to category 3 (insufficient data) for the 2010 Integrated Report. A TMDL for dissolved oxygen should adequately address any potential nutrient impairment, in the absence of numeric nutrient criteria and a quantitative assessment.

LDEQ is developing numeric nutrient criteria for waterbody types by ecoregions in accordance with LDEQ's plan *Developing Nutrient Criteria for Louisiana 2006*[1]. Waterbody types for nutrient criteria development in Louisiana are (1) inland rivers and streams; (2) freshwater wetlands; (3) freshwater lakes and reservoirs; (4) big rivers and floodplains/boundary rivers and associated waterbodies; and (5) estuarine and coastal waters, including up to Louisiana's 3-mile boundary in the Gulf of Mexico. LDEQ and EPA are reviewing proposed approaches for nutrient criteria development. Nutrient criteria can be implemented upon state promulgation and EPA approval per 40 CFR 131.21.

After nutrient criteria are developed, a subsequent quantitative assessment of the waterbodies, and the development of full nutrient models, nutrient limits can be established for all facilities discharging to impaired waterbodies in the Lake Pontchartrain Basin. LDEQ recommends that all facilities discharging this subsegment take a proactive approach and prepare to receive nutrient limitations in the near future. Such a proactive approach

[1] http://www.deq.louisiana.gov/portal/Portals/0/planning/LA%20Nutrient%20Strategy%20Plan%20Final%20FOR%20WEB.pdf. Accessed January 11, 2011.

should include nutrient monitoring and documentation through facility Discharge Monitoring Reports (DMRs) to assess their nutrient loads and the need to modify their treatment processes for nutrient removal.

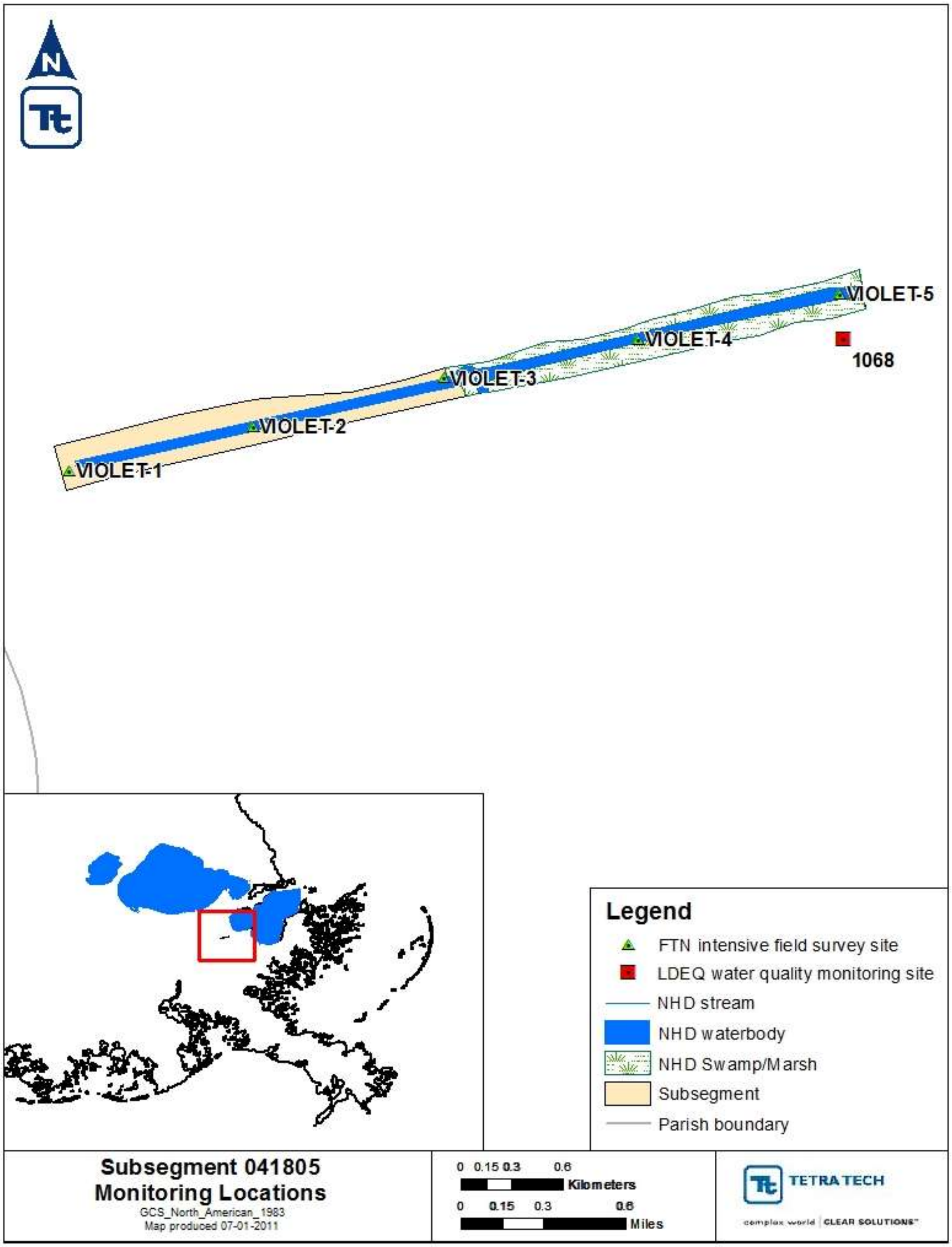


**Figure 3-1. Monitoring locations in subsegment 041805 in the Lake Pontchartrain Basin.**

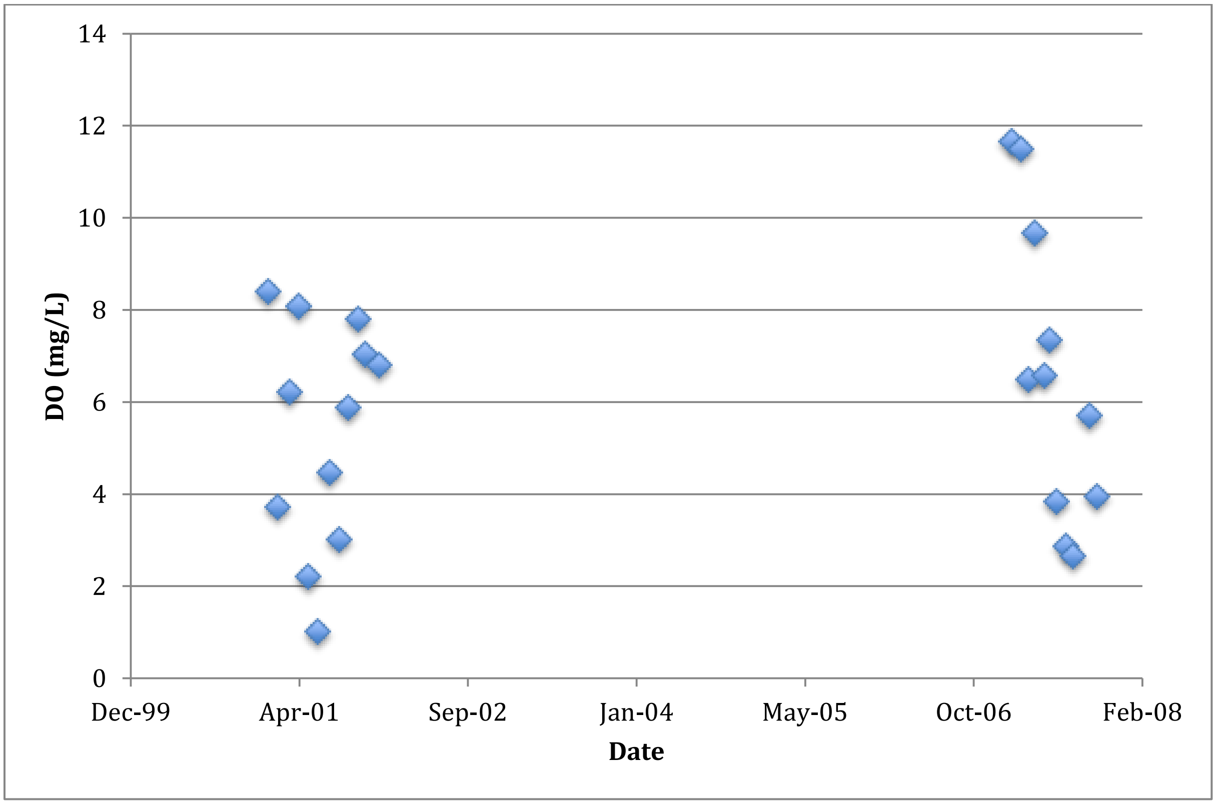


**Figure 3-2. DO concentrations over time at station 1068.**

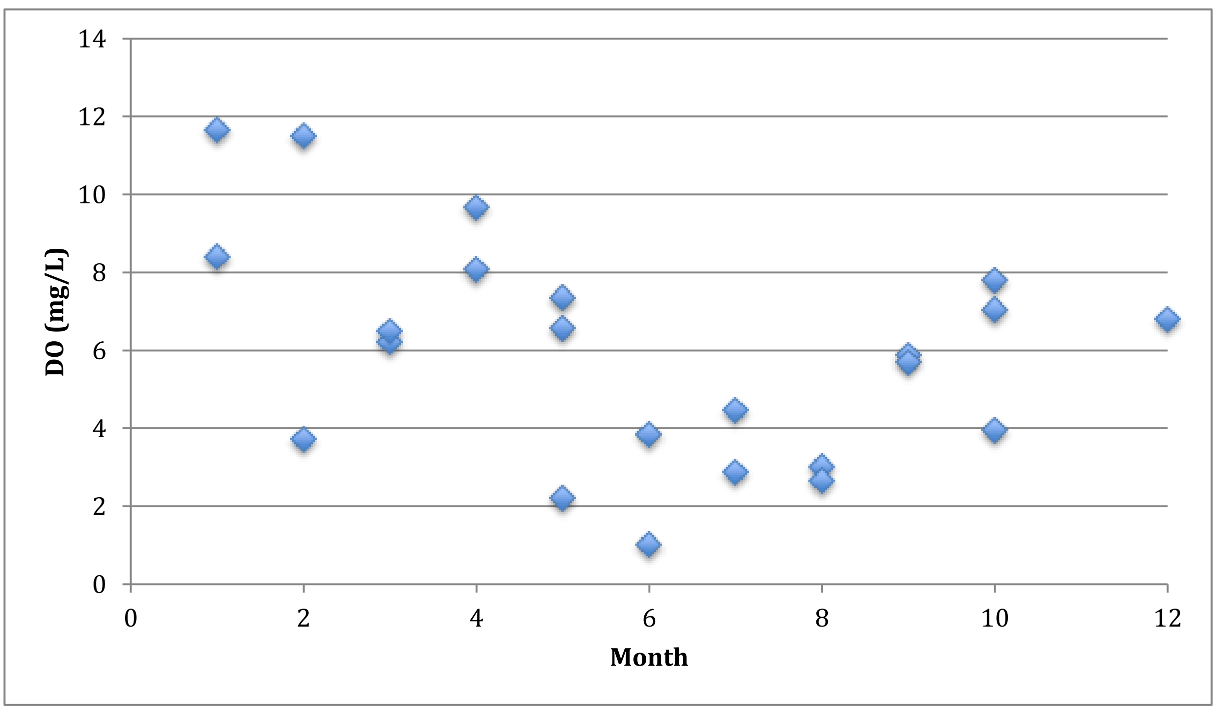


**Figure 3-3 Seasonal DO concentrations at station 1068.**

# 4. Model Setup and Calibration

## 4.1 Model Setup

LA-QUAL (Version 9.05) was chosen to simulate DO in the TMDL for subsegment 041805. LA-QUAL is a steady-state model that LDEQ developed based on the QUAL-TX (Version 3.4) model. Several modifications were made to the QUAL-TX model, including the addition of new aeration equations that better represent conditions in Louisiana. LA-QUAL evaluates the relationships between pollutant sources and water quality. Model configuration involved setting up the model segments and setting initial conditions, boundary conditions, and hydraulic and kinetic parameters. This section describes the configuration and key components of the model.

Only the main stems of the systems were explicitly simulated and thus segmented for modeling purposes. Segmentation refers to separating a waterbody into smaller computational units. Segmentation occurred around major hydrological features, such as tributaries. Tributaries were represented through boundary condition designation. Appendix C contains diagram of the model segmentations and stream kilometers.

During modeling, it is important to consider which factors contribute most to the DO depletion in Violet Canal. In general, CBOD, ammonia and sediment oxygen demand (SOD) will reduce water column DO, and algae can cause strong DO swing. During the July 2009 sampling period, no strong swing of DO was observed, indicating that DO depletion during that period is not caused directly by algae. Therefore, it is reasonable to assume that SOD and CBOD are the major causes for DO depletion in Violet Canal. DO collected in previous years have been below the 4 mg/L water quality criterion as shown in Figures 3-2 and 3-3. However, no flow and other data were collected.

## 4.2 Model Options (Data Type 2)

Data type 2 is used to identify the constituents being modeled to achieve calibration. For this TMDL, DO, BOD, conductivity, and a nitrogen series (ammonia nitrogen and nitrate+nitrite) were the constituents being modeled.

## 4.3 Program Constants (Data Type 3)

LA-QUAL is programmed with certain default program parameters, including those for tidal variability. Data type 3 is used to override the default parameters and is optional; that is, values need to be entered only if values other than the default values are desired. Default values were used for all program parameters except those listed in Table 4-1. For descriptions of the parameters and their default values, see the LA-QUAL user manual (Wiland Consulting, Inc. 2010).

**Table 4-1. Water quality kinetics rates**

| Program constant | Value range |
|---|---|
| Hydraulic calculation method | 2 |
| Inhibition control value | 3 |
| Ocean exchange ratio | 0.5 |
| Tidal height | 0.22 |
| Tidal period | 12 |
| Period of tidal rise | 6 |

## 4.4 Temperature Correction of Kinetics (Data Type 4)

Data type 4 contains factors used for temperature correction in rate equations. The temperature correction factors used in the model were consistent with the *Standard Operating Procedure for Louisiana TMDL Technical*

*Procedures* (LTP) when these factors were available (LDEQ 2010b). Default values were used for all factors. For descriptions of the factors and their default values, see the LA-QUAL user manual (Wiland Consulting, Inc. 2010).

## 4.5 Hydraulics and Dispersion (Data Types 9 and 10)

Data types 9 and 10 describe the hydraulic and dispersion characteristics of the model reaches. The stream hydraulics were specified in the input file for the model using the following power functions:

$$width = a \times Qb + c$$
$$depth = d \times Qe + f$$

where

| | | | |
|---|---|---|---|
| $a$ = | width coefficient | = | 0.0 |
| $b$ = | width exponent | = | 0.0 |
| $c$ = | width constant | = | average width of segment |
| $d$ = | depth coefficient | = | 0.0 |
| $e$ = | depth exponent | = | 0.0 |
| $f$ = | depth constant | = | average depth of segment |

The average width and depth data for each segment were based on measurements observed in July 2009; measurements are summarized in Table 4-2. Slight adjustments were made in some reaches to better simulate observed hydrology and water quality. Because the subsegment is tidally influenced, it was assumed that the average depth and width over a tidal cycle remain fairly constant unless sustainable high level of flow enters the system, which is not considered the case for this subsegment.

**Table 4-2. Average channel widths and depths for each model segment**

| Model reach | Width (m) | Depth (m) |
|---|---|---|
| 1 | 26.82 | 1.68 |
| 2 | 45.48 | 1.07 |
| 3 | 53.45 | 1.07 |
| 4 | 69.49 | 0.95 |

## 4.6 Initial Conditions (Data Type 11)

Initial conditions were set for temperature, DO, nitrate+nitrite, and chlorophyll *a* using observed water quality data, while ammonia data were set to a constant. Because LA-QUAL is a steady-state model, the initial conditions affect only the number of iterations needed to reach steady-state conditions. Setting initial conditions on the basis of observed data reduces the amount of iterations the model must perform to reach a steady state.

Salinity, nitrate+nitrite, phosphorus, phytoplankton, and macrophytes were the parameters not simulated in the model. Their initial conditions were set to zero so that the model would not assume a fixed concentration and include their effects.

## 4.7 Water Quality Kinetics (Data Types 12 and 13)

Several kinetic rates, including reaeration, SOD, CBOD decay, nitrification, and mineralization (organic nitrogen decay) rates were used in the model. Data types 12 and 13 focus on different rates used by the model. Data type 12 is needed only if BOD or DO is being simulated, and data type 13 is needed only if nitrogen or phosphorus is being simulated. For this TMDL, both data types were included.

The model calculates the reaeration rate by using one of a standard set of equations. For this TMDL, the O'Conner-Dobbins equation was used. This equation is applicable to moderately deep to deep channels (1 to 30 feet with flow between 0.5 feet per second and 12.2 feet per day). The O'Conner-Dobbins equation is

$$K_2 = \frac{3.932 \times V^{0.969}}{D^{1.5}}$$

where
$V$ = stream velocity (meters per second)
$D$ = stream depth (meters)

These values are provided in Appendix D as part of the output file results. Table 4-3 summarizes the water quality kinetics rates. The CBOD decay rate varied per subsegment and was based on the measured $CBOD_3$, $CBOD_5$, $CBOD_{12}$, $CBOD_{20}$, and $CBOD_{25}$ data. Slight adjustments were made in some reaches to better simulate observed water quality. The SOD was calibrated in the model and varied per subsegment reach. SOD was calibrated after the CBOD levels were finalized. The SOD rates changed iteratively until modeled DO concentrations agreed well with measured water column DO concentrations.

**Table 4-3. Water quality kinetics rates**

| Program constant | Value range |
|---|---|
| Background SOD ($g/m^2/d$) | 0.7–1.68 |
| CBOD #1 decay rate (aerobic) (1/d) | 0.05 |
| CBOD #1 settling rate (m/d) | 0.1 |
| Organic nitrogen decay rate (1/d) | 0.12 |
| Ammonia nitrogen decay rate (1/d) | 0.02 |
| Denitrification rate (1/d) | 0.02 |

## 4.8 Incremental Data (Data Types 16, 17, and 18)

Data types 16, 17, and 18 include information on inflows and outflows from the model reaches. For this TMDL, incremental information for flow, temperature, ammonia, $CBOD_u$, DO, organic nitrogen, and nitrate+nitrite was estimated during calibration. Appendix D contains the input values as part of the output file. Incremental flow was estimated based on water quality changes corresponding to flow adjustments during calibration. In addition to incremental inflows, water is withdrawn from segments 3 and 4 of the canal following the analysis by FTN concluding that water in the Violet Canal can spread to small tributaries on the mud flat and flow should be higher near upstream and lower toward downstream. The withdrawal rate of flow was also estimated as a calibration factor.

## 4.9 Headwater Flow, Water Quality, and Junction Data (Data Types 20, 21, 22, and 23)

Data types 20, 21, 22, and 23 account for flow and water quality from upstream of the modeled subsegment. Headwater flow and water quality data were derived from monitoring data. In general, the flow measured at the most upstream station was taken as the headwater flow. Water quality data (mainly $CBOD_u$ and DO) were estimated from the monitoring data collected from the most upstream stations.

## 4.10 Wasteload Flow and Water Quality Data (Data Types 24, 25, and 26)

Data types 24, 25, and 26 account for flow and water quality from point sources discharging into the listed waterbodies. The model included one permitted outflow. Stormwater permits are considered point sources; however, for modeling purposes in this TMDL, they are entered as a nonpoint source. The inputs and their associated flows and concentrations are provided in Table 4-4. DO was set to 2.0 for the point source. The average flow was used, and the permitted $BOD_5$ discharge limits were converted to $CBOD_u$ by assuming that $BOD_5$ was approximately equal to $CBOD_5$ and then using a conversion factor of 2.3 to convert to $CBOD_u$.. Organic nitrogen and nitrate+nitrite were assumed on the basis of the $BOD_5$ discharge limit.

**Table 4-4. Summary of calibration point source data used in LA-QUAL**

| Point source | Flow (gpd) | DO (mg/L) | $CBOD_u$ (mg/L) | Org N (mg/L) | Ammonia (mg/L) | $NO_3$+$NO_2$ (mg/L) |
|---|---|---|---|---|---|---|
| LAG531277 | 1,310 | 2.0 | 130.5 | 7.5 | 15.0 | 2.0 |

# 4.11 Calibration and Sensitivity Analysis

## 4.11.1 Calibration

Model calibration is a critical step for model development. Calibration data must be collected in all the parameters of the model at the same time, as much as practical. Only data taken in that manner can be used for the calibration because many of the parameters and rates are dependent on each other. Analysis of the data for calibration indicated some conditions that formed assumptions in the model. The process of the calibration confirms the assumptions or requires revised assumptions. In certain instances, calibrated models are not required to produce valid TMDLs.

Model calibration also depends on the available data and should not be considered data matching. For this model, the magnitude and spatial trends are all captured with reasonable assignment of kinetic rates. Rates were not purposely changed in each reach to exactly match data. The calibration period was selected to coincide with the intensive field monitoring that had occurred in July 2009. The data used for calibration are the averages of the samples taken on July 9, 2009. That date was selected for calibration because it was the only date for which data were available. The date is considered the critical condition because high temperatures decrease DO saturation values and increase rates for oxygen-demanding processes, such as BOD decay, nitrification, and SOD. In addition, lower flow rates do not cause strong reaeration, therefore the exchange of oxygen between air and water is low.

Model calibration was a multi-step process using ammonia, $CBOD_u$, and SOD concentrations for each reach, starting with the most upstream reach and working down to the outflow reach. Organic nitrogen was first adjusted so that predicted concentrations matched observed data. The ammonia and nitrate loads were then adjusted so that the predicted nitrogen concentrations would match the observed concentrations. After ammonia was calibrated, the $CBOD_u$ loads were adjusted until the predicted $CBOD_u$ concentrations were similar to the observed concentrations. Finally, SOD was adjusted until the predicted DO concentrations were similar to the observed concentrations.

Table 4-5 lists the loadings for calibration conditions, which were based on existing conditions. Overall, the model did well in predicting the observed values for temperature, ammonia, $CBOD_u$, and DO, and was considered adequately calibrated on the basis of the data available. Plots of observed and calibration water quality are presented in Appendix E. Figure 4-1 is an example calibration plot.

**Table 4-5. Calibration (existing) modeled loadings**

| Loadings (lb/d) | | | |
|---|---|---|---|
| SOD | $CBOD_u$ | Ammonia as N | Organic N as N |
| 1,142 | 18,416 | 132 | 1,524 |

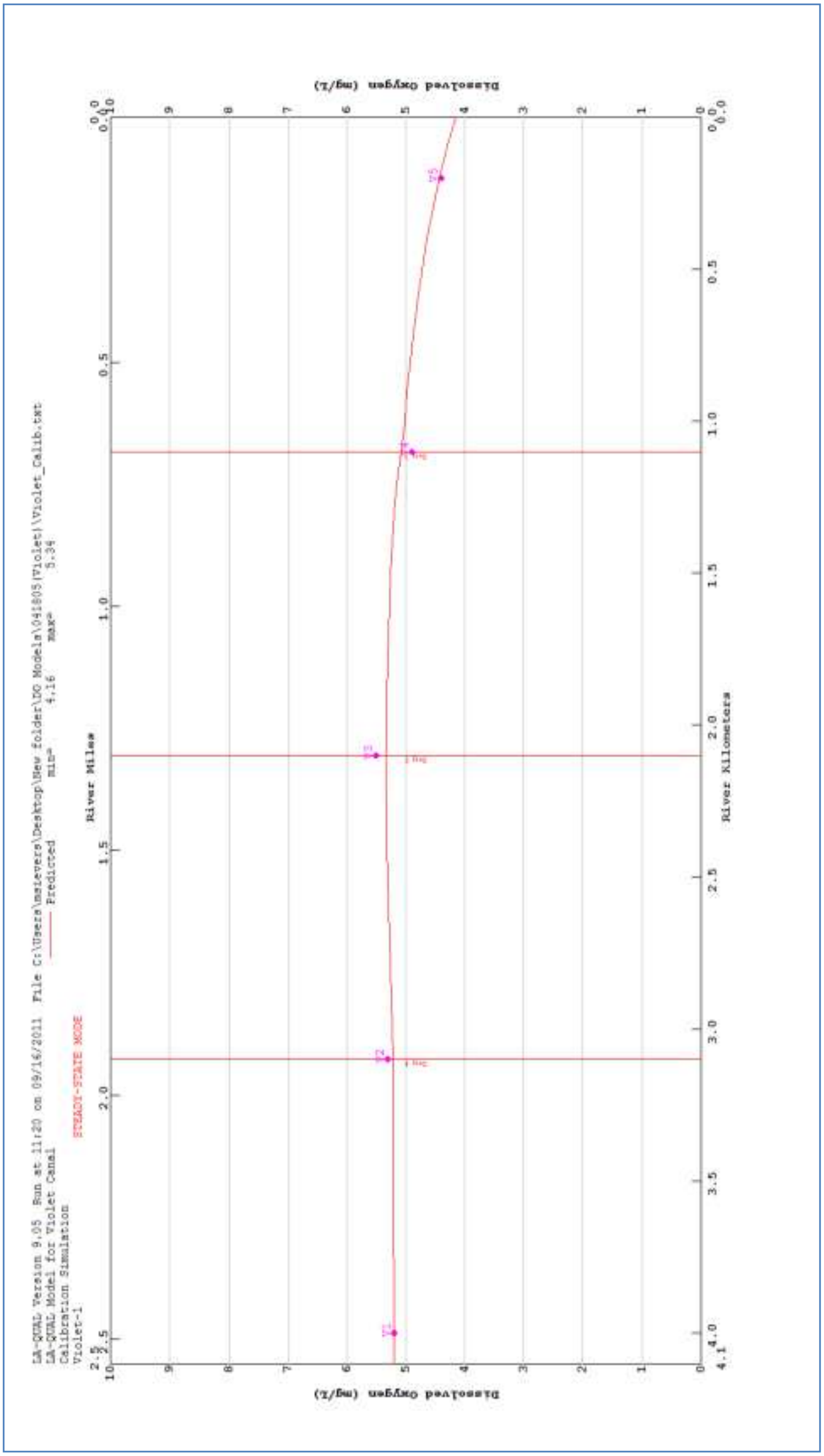


Figure 4-1. Calibration plot for DO in subsegment 041805.

### 4.11.2 Processes Identified through Calibration

The adjustment of the model rates and coefficients made to help modeled flow and loads agree with observed data for significant pollutants led to an understanding of the processes controlling the conditions of Violet Canal. On the basis of the calibration of the model, the low DO problem in Violet Canal is mainly caused by SOD and CBOD.

### 4.11.3 Sensitivity Analysis

Because a mathematical model is a simplified representation of the real world, its prediction is often subject to considerable uncertainty from a variety of sources. These sources include over-simplification of modeling assumptions and formulations, noise-distorted data, and model parameter values. It is important to gain a better understanding of a model's reliability by analyzing the uncertainty associated with a model. Sensitivity analysis is a prime method of measuring a model's uncertainty and reliability. Sensitivity is related to the actual waterbody or water system. For example, reaeration in a narrow mountain stream is highly related to velocity, while reaeration for a wide river in flat area is related to both wind and water velocity. Sensitivity runs will provide useful information on understanding the physical, chemical, and biological processes in a specific waterbody. In this model, the sensitivity of the DO concentration to various parameters was examined. The analysis was performed by assessing the effects of the following:

- Velocity
- Dispersion
- Reaeration
- CBOD aerobic decay rate
- Background SOD

SOD is a result of deposition of dead phytoplankton and other organic matters from the watershed and has direct influence of DO levels in the water column. CBOD loading from the watershed contributes to the oxygen demand and can be the source of SOD. Therefore, SOD is included in the sensitivity analysis.

A sensitivity analysis was performed on the model parameters using the sensitivity function built into LA-QUAL. LA-QUAL automatically changed the requested parameters by a set amount while keeping all other parameters constant. The calibration scenario was used as the baseline for the sensitivity analysis. For the analysis, all parameters were varied by ±30 percent. The results for CBOD and DO are shown in Table 4-6. Result plots are included in Appendix F.

**Table 4-6. Results of sensitivity analysis**

| | DO min/max (mg/L) | | | | | CBOD min/max (mg/L) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CBOD aerobic decay rate | dispersion | reaeration | Background SOD | velocity | CBOD aerobic decay rate | dispersion | reaeration | Background SOD | velocity |
| **base** | 4.16/5.34 | 4.16/5.34 | 4.16/5.34 | 4.16/5.34 | 4.16/5.34 | 12.52/13.45 | 12.52/13.45 | 12.52/13.45 | 12.52/13.45 | 12.52/13.45 |
| **30%** | 4.15/5.30 | 4.16/5.34 | 4.20/5.46 | 4.13/5.30 | 4.21/5.36 | 12.49/13.43 | 12.52/13.45 | 12.52/13.45 | 12.52/13.45 | 12.56/13.46 |
| **-30%** | 4.18/5.39 | 4.16/5.34 | 4.12/5.23 | 4.20/5.40 | 4.10/5.30 | 12.54/13.47 | 12.52/13.45 | 12.52/13.45 | 12.52/13.45 | 12.45/13.44 |

Each sensitivity variable is discussed below:

- When the stream velocity is increased or decreased, DO reaeration rates change correspondingly and DO will increase in faster water and decrease in slower water.
- Stream dispersion mixes and spreads material longitudinally. The sensitivity results show no change of DO with increased or decreased dispersion.
- Stream reaeration rates govern how fast oxygen transfers through the air-water interface. High reaeration rates will bring water oxygen levels closer to the saturation level of DO. In Violet Canal, DO will increase with higher reaeration rates and decrease with lower reaeration rates.

- CBOD is one cause of DO depletion. When CBOD decays, oxygen is used. The sensitivity results show that DO is slightly changed when the decay rates are changed.
- DO is sensitive to the background SOD rates. When SOD rates increase, DO becomes lower. When SOD rates decrease, DO increases.

# 5. Dissolved Oxygen Model Projection

EPA's regulations at 40 CFR 130.7 require that parties determining TMDLs take into account critical conditions for stream flow, loading, and water quality parameters. The calibrated model was used to project water quality for summer and winter critical conditions. Two scenarios were run for each season's critical conditions at Violet Canal: baseline and TMDL. The model was run for baseline conditions, which used the same water quality and model parameters as the calibration model; however, the flow and temperature were changed to critical conditions and effluent water quality from permitted dischargers were changed to permit limits. The TMDL model run was the same as the baseline run; however, pollutant loadings were reduced so that DO met criteria at all locations. This section describes identification of critical conditions, temperature inputs, headwater and tributary (wasteload) inputs, point source inputs, baseline model results, and TMDL reduction model rates. Appendix G contains the baseline output files and Appendix H contains the TMDL output files. The output files include the input parameters.

## 5.1 Identification of Critical Conditions

The LDEQ LTP defines critical conditions in terms of flow and temperature. Critical flow conditions for the summer scenario are simulated by using the annual 7Q10 flow or 0.1 cubic feet per second (cfs), whichever is greater. For winter, the critical flow condition is simulated using the annual 7Q10 flow or 1.0 cfs, whichever is greater. In addition, all point sources are assumed to be discharging at design capacity and at their permit limits. The LTP specifies that the critical temperature should be determined by calculating the 90$^{th}$ percentile seasonal temperature for the waterbody being modeled, if data are available. Otherwise, 30 ºC was used for summer and 20 ºC for winter critical conditions.

## 5.2 Temperature Inputs

The critical temperatures for the headwaters were based on the 90$^{th}$ percentile temperature of LDEQ ambient monitoring in the representative subsegment. For summer conditions, a critical temperature of 30 °C was used for incremental and wasteload inputs, unless the temperature was already greater than 30 °C, in which case the temperature was kept the same as calibration. For winter conditions, a critical temperature of 20 °C was used for incremental and wasteload inputs. The most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows.

## 5.3 Headwater and Tributary (Wasteload) Inputs

The inputs for the headwater and tributaries for the projection simulation were based on guidance in the LTP. According to the LTP, the critical flow rates for summer should be set to either the 7Q10 flow or 0.1 cfs, whichever is greater, and either the 7Q10 or 1 cfs in the winter. Because 7Q10 values for the waterbodies are not available, the headwater and tributary flows used in calibrating the model were replaced with 0.1 cfs for the summer scenario and 1 cfs for the winter scenario. It was assumed that during critical times, there might not be headwater flow for 7 days, making the 7Q10 equal to 0 cfs; therefore 0.1 cfs and 1 cfs would be used.

DO from headwaters and tributaries were set to the water quality criterion of 4 mg/L or the observed concentration, whichever was greater. CBOD levels from headwaters and tributaries were reduced until modeled DO met the criteria. The ammonia levels were low from both the headwaters and tributaries; therefore, the ammonia inputs were not changed from the calibration values.

## 5.4 Point Source Inputs

Input point sources were kept at the same flow as the calibration inputs.

## 5.5 Baseline Model Results

The calibrated model was run for a baseline condition. Baseline conditions are run under critical temperature and water flow conditions for summer and winter using calibrated parameters and water quality values. The baseline condition is essentially the starting point for TMDL analysis from which loading reductions are made because it represents the critical conditions and the calibrated model. Baseline line conditions were run under critical temperature and water flow conditions for calibrated parameters and water quality values. Plots of baseline water quality are presented in Appendix I. Table 5-1 presents the baseline oxygen demand for subsegment 041805. These loadings are less than the calibration results (Table 4-5) due to the critical condition assumptions.

**Table 5-1. Baseline model loadings**

| Season | Loadings (lb/d) | | | |
|---|---|---|---|---|
| | SOD | $CBOD_u$ | Ammonia as N | Organic N as N |
| Summer | 1,142 | 21.08 | 0.27 | 1.12 |
| Winter | 592.6 | 200.6 | 1.24 | 10.49 |

## 5.6 TMDL Reduction Model Results

The model demonstrates that with loading reductions, the canal will meet DO criteria (Figure 4-3). For projection runs, the flow (0.1 cfs) and weather conditions were kept identical to the baseline conditions. Only load inputs such as SOD and CBOD from the drainage basin were changed in order to determine the loadings for the TMDL.

Several steps were used to develop the reduction percentages for oxygen demand. The TMDL was calculated by first iteratively reducing SOD. After meeting the DO criterion by reducing SOD, the CBOD reduction rate was calculated by the SOD/CBOD relationship ($SOD = a \times \sqrt{CBOD}$). This equation assumes that the settled $CBOD_u$ is linearly related to the $CBOD_u$ load. The loading of CBOD is in mg/L of $O_2$, and the settled CBOD is in m/$m^2$/d of $O_2$. Slight adjustments were made to the SOD reduction rate, and an updated CBOD reduction rate was calculated. This process was repeated until the optimal reduction rates were determined.

Plots of TMDL water quality are presented in Appendix J.

# 6. Dissolved Oxygen TMDL Development

A TMDL is the total amount of a pollutant that a receiving waterbody can assimilate while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established, thereby providing the basis for establishing water quality-based controls.

A TMDL for a given pollutant and waterbody is calculated using the sum of individual WLAs for point sources and LAs for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account any lack of knowledge concerning the relationship between load and wasteload allocations and water quality, and it may include a future growth (FG) component. The components of the TMDL calculation are illustrated using the following equation:

$$TMDL = \Sigma WLAs + \Sigma LAs + MOS + FG$$

This TMDL establishes load allocations for oxygen-demanding substances and goals for reduction of those pollutants. LDEQ's position is that when oxygen-demanding loads are reduced in order to ensure that the DO criterion is supported, nutrients are also reduced. The implementation of this TMDL through discharge permits and implementation of best management practices (BMPs) to control and reduce runoff of oxygen-demanding pollutants will also reduce the nutrient loading from those sources.

## 6.1 TMDLs, WLAs, and LAs

The DO TMDLs are presented as oxygen demand from $CBOD_u$, ammonia nitrogen, and SOD, and they were derived using the LA-QUAL model. A summary of the TMDLs is presented in Table 6-1. The TMDLs were calculated from SOD, $CBOD_u$, ammonia, and organic nitrogen from nonpoint source model inputs, tributary flows, incremental flows, and background data.

**Table 6-1. Summary of DO TMDLs, WLAs, LAs, MOSs, and FGs**

| Season | Loadings (lb/d) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Summer | SOD | | $CBOD_u$ | | Ammonia as N | | Organic N as N | |
| | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL |
| WLA | 177.2 | 126.5 | 4.18 | 2.67 | 0.174 | 0.174 | 0.240 | 0.240 |
| LA | 736.2 | 525.8 | 12.68 | 6.38 | 0.043 | 0.043 | 0.658 | 0.658 |
| MOS | 114.2 | 81.5 | 2.11 | 1.13 | 0.027 | 0.027 | 0.112 | 0.112 |
| FG | 114.2 | 81.5 | 2.11 | 1.13 | 0.027 | 0.027 | 0.112 | 0.112 |
| TMDL | 1,141.6 | 815.5 | 21.08 | 11.30 | 0.272 | 0.272 | 1.122 | 1.122 |
| Percent reduction | 28.6% | | 46.4% | | 0.0% | | 0.0% | |
| Season | Loadings (lb/d) | | | | | | | |
| Winter | SOD | | $CBOD_u$ | | Ammonia as N | | Organic N as N | |
| | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL | Baseline | TMDL |
| WLA | 92.0 | 92.0 | 32.04 | 32.04 | 0.32 | 0.32 | 1.69 | 1.69 |
| LA | 382.2 | 382.2 | 128.43 | 128.43 | 0.67 | 0.67 | 6.70 | 6.70 |
| MOS | 59.3 | 59.3 | 20.06 | 20.06 | 0.12 | 0.12 | 1.05 | 1.05 |
| FG | 59.3 | 59.3 | 20.06 | 20.06 | 0.12 | 0.12 | 1.05 | 1.05 |
| TMDL | 592.6 | 592.6 | 200.58 | 200.58 | 1.24 | 1.24 | 10.49 | 10.49 |
| Percent reduction | 0.0% | | 0.0% | | 0.0% | | 0.0% | |

### 6.1.1 Wasteload Allocation

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. The permitted or average (expected or observed) flows were used to calculate the WLAs. The WLAs are presented in Table 6-2. There were no reductions in point sources.

**Table 6-2. WLAs for subsegment 041805 in the Lake Pontchartrain Basin**

| Agency interest (AI) # | NPDES permit # | Outfall | Facility name | Flow type | Flow (gpd) | Measurement | $BOD_5$ | $CBOD_u$ | Amm | Org N |
|---|---|---|---|---|---|---|---|---|---|---|
| 20849 | LAG531277 | 001 | Violet Chevron | Average | 1,310 | Loading (lb/d) | 0.492 | 1.13 | 0.164 | 0.082 |
| | | | | | | Concentration (mg/L) | 45.0 | 103.5 | 15.0 | 7.5 |

Note: The official WLA is $CBOD_u$. $BOD_5$ is presented as a comparison to a commonly measure parameter. $BOD_5$ is converted to $CBOD_u$ by assuming that $BOD_5$ was approximately equal to $CBOD_5$ and then using a conversion factor of 2.3 to convert to $CBOD_u$.

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. For the MS4 in the basin, a gross MS4 load was computed by multiplying the LA by the ratio of the MS4 area in each subsegment (45 acres) to the subsegment area (232 acres). Note that these values are estimates that can be refined in the future as more information about the MS4s and land-use-specific loadings becomes available. Note also that the MS4 loads presented reflect only that portion of the MS4 in the subsegment. The computed MS4 load was subtracted from the LA and included as a WLA component of the TMDL because MS4s are permitted dischargers but function similarly to nonpoint sources (through storm-driven processes). In addition, the TMDL was developed for critical low flow conditions, when stormwater is not expected to play a role in loadings.

Table 6-3 lists the individual WLAs for the MS4s identified in Section 2.5. LPDES permitted discharges without DO or nutrient effluent limitations have been determined to not be sources of these. For these dischargers, LDEQ is not providing allocations or permit limits. If at some point in the future, LDEQ determines that any of the discharges may contain these parameters, WLAs may be provided along with the appropriate permit conditions. MS4 WLAs are not intended to be used as permit limits or targets. Permit limits will not be applied to MS4 permittees. EPA expects that the MS4 WLAs will be achieved through BMPs and adaptive management.

**Table 6-3. Summary of WLAs for MS4s subsegment 041805 in the Lake Pontchartrain Basin**

| NPDES permit # | Agency interest (AI) # | Urban area (UA) | MS4 area (acres) | Season | Pollutant | MS4 (lb/d) |
|---|---|---|---|---|---|---|
| LAR040003 | 108277 | St Bernard Parish Government - Municipal Separate Storm Sewer System | 45.00 | Summer | $CBOD_u$ | 1.53 |
| | | | | | Organic nitrogen as N | 0.158 |
| | | | | | Ammonia as N | 0.010 |
| | | | | | SOD | 126.5 |
| | | | | Winter | $CBOD_u$ | 30.90 |
| | | | | | Organic nitrogen as N | 1.61 |
| | | | | | Ammonia as N | 0.161 |
| | | | | | SOD | 91.96 |

The estimated annual runoff from the MS4 can be calculated with the following equation.

$$R = P \times Pj \times Rv$$

where

$R$ = Annual runoff (inches)
$P$ = Annual rainfall (inches)
$Pj$ = Fraction of annual rainfall events that produce runoff (usually 0.9)
$Rv$ = Runoff coefficient

Because watershed imperviousness is a reasonable predictor of the runoff coefficient, the runoff coefficient was substituted using the following equation.

$$Rv = 0.05 + 0.9Ia$$

where

$Ia$ = Impervious fraction

The estimated annual runoff from the MS4 was calculated to be 18.72 inches per year. For that calculation, the average annual rainfall (58 inches) was calculated using the past 14 years of complete data collected by the National Climatic Data Center at New Orleans International Airport. The impervious fraction of the MS4 was estimated to be 34 percent using impervious area information from USGS. Once the runoff in inches was calculated, it was multiplied by the area to obtain the runoff is 22.9 million gallons per year (62,700 million gallons per day [gpd]).

### 6.1.2 Load Allocation

The LA is the portion of the TMDL assigned to nonpoint sources such as natural background loadings or upstream sources. For this TMDL, the LA was calculated by subtracting the WLA, MOS, and FG from the total TMDL allocation. LAs were not allocated to separate nonpoint sources, such as water entering from Lake Borne or the Mississippi River Gulf Outlet, because of the lack of available source characterization data. The LA covers the 187 acres not covered in the MS4 WLA (Table 6-3).

## 6.2 Seasonality and Critical Condition

The federal regulations at 40 CFR 130.7 require that TMDLs include seasonal variations and take into account critical conditions for stream flow, loading, and water quality parameters. The sampling results for all pollutants were plotted over time and reviewed for any seasonal patterns (see Section 3). The water quality criteria for DO apply all year accounting for seasonal variations. This TMDL was developed under critical conditions, providing a conservative year-round TMDL.

Critical conditions for DO have been determined to be the following: negligible nonpoint runoff and low-stream flow combined with high water temperatures. Oxygen-demanding substances can enter a water system during higher flows and settle to the bottom, where they exert a large oxygen demand during the high-temperature/low-flow seasons. Water temperature is one of the leading factors that affect DO in the segment. High water temperatures lower the DO saturation concentration, decreasing the amount of DO that the stream can contain. In addition, high temperature increases CBOD decay and SOD. Therefore, it is most important to develop a TMDL to address the high-water-temperature conditions. Ambient water quality data from LDEQ show that low DO concentrations occur during the summer months.

## 6.3 Margin of Safety

Section 303(d) of the Clean Water Act and the regulations at 40 CFR 130.7 require that TMDLs include an MOS to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly using conservative assumptions in establishing the TMDL. In addition to the MOS, an FG component may be added to account specifically for FG in the TMDL area.

The MOS can be incorporated in two ways (USEPA 1991). One way is to implicitly incorporate it by using conservative model assumptions to develop allocations, including using the DO water quality criteria for model inflows. DO from headwaters and tributaries was set to the water quality criterion, which is lower than the 90 percent saturation level of DO at 30 ºC.

The other way to incorporate the MOS is to explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this analysis, the MOS is explicit: 10 percent of each targeted TMDL was reserved as the MOS. Using 10 percent of the TMDL load provides an additional level of protection to the designated uses of the subsegments of concern.

## 6.4 Future Growth

The FG is an allocation for growth. Ten percent of the load was allocated for FG in the area covered by the TMDL. This growth includes future urban development, including point sources, MS4 areas, agriculture, and other nonpoint sources. The FG could also be used for sources not accounted for or unknown and therefore not otherwise included in the TMDL.

# 7. Future Activities

This section discusses TMDL implementation strategies, environmental monitoring activities, and stormwater permitting requirements and presumptive best management practices approach for the TMDL conducted for the Violet Canal.

## 7.1 TMDL Implementation Strategies

Current TMDL requirements do not require implementation plans to be included in TMDL reports. Louisiana is responsible for developing and implementing the TMDL implementation plans. Section 303(d) of the Clean Water Act and the implementing regulations at 40 CFR 130.7 state that EPA has no authority to approve or disapprove TMDL implementation plans.

WLAs will be implemented through LPDES permit procedures. LDEQ was delegated to manage the NPDES program in August 1996, and LDEQ is responsible for all permits covered by the delegation package. As part of that designation, a Memorandum of Agreement (MOA) was established between LDEQ and EPA. The designation and memorandum were revised in April 2004. In accordance with Section 1.C of the NPDES MOA between LDEQ and EPA (Revision 1, April 28, 2004), EPA has the responsibility of providing continued technical and other assistance, including interpreting and implementing federal regulations, policies, and guidelines on permitting and enforcement matters. The MOA further states that LDEQ has primary responsibilities for implementing the LPDES program in Louisiana, including applicable sections of the federal Clean Water Act, applicable state legal authority, the applicable requirements of 40 CFR Parts 122–125, and any other applicable federal regulations establishing LPDES program priorities with consideration of EPA Region 6 and national NPDES goals and objectives. For details on the designation and agreement, see the EPA Region 6 website at http://www.epa.gov/region6/water/lpdes/.[2] LDEQ's position is that, if any unresolved LDEQ comments to these TMDLs become the basis for an EPA Region 6 objection of an LDEQ-drafted permit or permittee objection/appeal of an LDEQ drafted permit, LDEQ may relinquish permitting authority to EPA Region 6.

## 7.2 LDEQ Phased TMDL Approach

LDEQ is using a phased approach to TMDL implementation, as shown in Table 7-1. This approach provides LDEQ with the opportunity to revise a DO criteria for a subsegment by developing a meaningful and implementable DO TMDL on the basis of DO criteria that is appropriate for a specific waterbody and in accordance with the Consent Decree deadlines. In addition, it will lead to improved water quality while providing entities the opportunity to prepare for potential new permit requirements as a result of the TMDL developed in Phases I and II (LDEQ 2010d).

**Table 7-1. Phased TMDL Approach**

| Stage/Phase | DO criteria (mg/L) |
|---|---|
| **Phase I:** Phase I implementation required upon EPA approval of the TMDL and subsequent update of Louisiana's Water Quality Management Plan | 4.0 |
| **Primary Activities:** Ecoregion-based UAA developed and DO criteria revised and promulgated | |
| **Phase II:** Phase II implementation required upon EPA approval of Phase II of the TMDL and subsequent update of Louisiana's Water Quality Management Plan | Appropriate DO criteria based on UAA |

UAA = Use attainability analysis

### 7.2.1 Phase I - Permit Implementation

All TMDL, permitting, and enforcement activities will be conducted in accordance with the Clean Water Act, the Louisiana Environmental Regulatory Code, and applicable state laws.

[2] Accessed January 11, 2011.

1. **New discharges of oxygen-demanding loads:** Because of the outstanding natural resource water status of Violet Canal (subsegment 041805), the waterbody is afforded Tier 3 protection, according to 40 CFR 131.12 (a)(3). New or increased discharges that would cause degradation, as defined in LAC 33:IX.1119.C.4, will not be approved. However, LDEQ may permit new discharges on a case-by-case basis after evaluating relevant information (i.e., environmental impact statement). Such new facilities may be required to submit an environmental impact assessment to LDEQ's permitting staff, which will conduct a thorough evaluation of the proposed facility based on environmental impacts, economic benefits, an analysis of alternatives, and other pertinent factors. The typical permit limits will be 5 mg/L for $BOD_5$, 2 mg/L for $NH_3$, and 5 mg/L for DO. Example scenarios where a new discharge may be permitted are as follows.
   a. The facility demonstrates that it will provide a significant load reduction of man-made oxygen-demanding constituents to the impaired watershed(s) serviced by the facility. The facility must also contribute to a reduction in the number of facilities discharging to the watershed(s). Facilities that may be considered for permits under this provision include the following:
      i. A facility that will provide improved sewage treatment to multiple subdivisions previously serviced by wastewater treatment plants that are incapable of treating to tertiary limits.
      ii. A facility that will provide sewage collection and treatment to previously unsewered areas in which many of the sanitary discharges from permitted facilities and individual home treatment units were entering an impaired watershed. As a result, the facility would be expected to provide more efficient treatment to the wastewater and reduce the net loading of oxygen-demanding substances in the watershed.
   b. The facility demonstrates that its wastewater will not leave the facility or its property. Significant stormwater events do not apply to this provision. For this provision, a significant stormwater event is defined as a 25-year, 24-hour rainfall event or its numerical equivalent, as defined by the Southern Regional Climate Center.
      i. Facilities that may be considered under this provision include the following:
         a. Effluent reduction and/or "no discharge" systems that have been approved by the Louisiana Department of Health and Hospitals
         b. Wastewater treatment plants equipped with overland flow systems in which the effluent will not leave the facility
         c. Wastewater treatment plants equipped with holding ponds that will retain the effluent such that the effluent will not leave the facility
      ii. LDEQ recognizes that some local governments are in the process of building or expanding regional sewage collection and treatment systems. In such areas, LDEQ may, on a limited basis, grant permits of limited durations to facilities that agree to tie into a regional collection and treatment system when it becomes available. LDEQ must have assurance that the regional collection system will be available to the facility and the facility will connect to the regional collection system on or before the expiration date of the permit. Such assurance may include a formal agreement among the facility, the owner and operator of the regional wastewater treatment system, and LDEQ. The regional system must have the capacity to treat the additional wastewater. Such a permit may have a duration of less than 5 years or it may have a 5-year duration with interim permit limits. The permit will be written on the basis of projected completion dates for the construction of the collection and treatment system. The facility will be required to cease all wastewater discharges to the Violet Canal watershed and transfer the discharge to the regional collection system once the permit or interim limits expire or the collection system is available to the facility, whichever comes first. If the permit or interim limits expire, but, because of unforeseen circumstances, the availability of the collection system has

been temporarily delayed, the duration of the permit or interim limits may be extended. If the availability of the collection system has been indefinitely delayed, the facility may be required to consider alternatives. Such alternatives may include processes that lead to a reduction or complete removal of the discharge to Violet Canal, such as those outlined in item 1.b.i above or the use of a different flow path to state waters.

c. LDEQ reassesses Subsegment 041805, Violet Canal. LDEQ determines that subsegment 041805 is meeting the appropriate DO criteria and designated uses.

2. **Existing discharges of oxygen demanding loads:** The Phase I permit limits for existing dischargers in the Violet Canal Watershed are presented in Table 4-4. Existing facilities discovered to be discharging oxygen-demanding loads without LPDES permits as of the TMDL approval date are to be permitted in accordance with the limits established for existing facilities with permits. Unpermitted facilities that are newly activated or reactivated and discharging after the TMDL approval date may be subjected to enforcement actions and will be required to tie into regional collection and treatment systems, once those systems are available. Once the TMDL is approved, existing facilities may have up to 3 years from their next permit renewal date to meet the interim limits.
3. **Monitoring:** Nutrient monitoring (e.g., reporting for total nitrogen and total phosphorus) might be required for individual permits. Nutrient monitoring will be added to the general permit series (LAG530000, LAG540000, LAG560000, and LAG570000) in the next scheduled renewal of each series.

### 7.2.2 Phase II – Use Attainability Analysis Implementation

Phase II permit implementation will be developed on the basis of an ecoregion-based use attainability analysis (UAA), which is being developed. According to existing data, the UAA is expected to propose new DO criterion for many of the Lake Pontchartrain Basin TMDLs that are being developed. Those TMDLs have an EPA backstop date of March 31, 2012. The new DO criterion is expected to be developed and promulgated within the next 2 to 3 years.

If new criteria are not developed and promulgated within 5 years from the TMDL approval date, LDEQ intends to proceed as follows

- **Case 1:** If the UAA study indicates that the current DO criterion is appropriate, the TMDL will be implemented using the existing criterion.
- **Case 2:** If the UAA is not likely to be completed or approved, the TMDL will be implemented using the existing DO criterion.
- **Case 3:** If the UAA is still being developed, but is expected to be approved, then Phase II of this TMDL will be postponed for up to 2 years. If by then the UAA has not been completed, the UAA status will be reviewed again according to Cases 1–3.

## 7.3 Environmental Monitoring Activities

LDEQ uses funds provided under section 106 of the Clean Water Act and under the authority of the Louisiana Environmental Quality Act to run a program for monitoring the quality of Louisiana's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations using appropriate sampling methods and procedures to ensure the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term database for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program are used to develop the state's biennial section 305(b) report (*Water Quality Inventory*) and section 303(d) list of impaired waters (*Draft 2010 Integrated Report*).

LDEQ has implemented a rotating approach to surface water quality monitoring. Through the rotating approach, the entire state is sampled on a 4-year cycle. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the 4-year cycle. Sampling is conducted monthly during a water year (October through September) to yield approximately 12 samples per site during each year the site is monitored. Sampling locations are selected where they are considered representative of the waterbody. Under the current monitoring schedule, approximately one-half of the state's waters are newly assessed for section 305(b) and section 303(d) listing purposes for each biennial cycle. Monitoring allows LDEQ to determine whether any improvement in water quality occurred after the TMDLs had been implemented. LDEQ evaluates the monitoring results to generate the Integrated Report submitted by April 1 on even-numbered years. More information can be found in *Louisiana's Water Quality Assessment Method and Integrated Report Rationale: 2010 Water Quality Integrated Report* (LDEQ 2010a). Monitoring will allow LDEQ to determine whether there has been any improvement in water quality following TMDL implementation. As the monitoring results are evaluated at the end of each year, waterbodies might be added to or removed from the section 303(d) list of impaired waterbodies.

Two watershed coordinators have been hired to work with the Lake Pontchartrain Basin Foundation (LPBF) on stakeholder involvement for watershed plans. LDEQ's nonpoint source staff is also working with the LPBF to implement these plans, and will be assigned additional watersheds to work on through the planning and implementation process. In order to address some of the known problems that exist within this basin, LDEQ has been implementing programs that address fecal coliform, DO, and mercury, which are the primary water quality problems that have been identified in these waterbodies. LPBF has implemented many programs to restore water quality, and will be an important partner for LDEQ as TMDLs are implemented within the basin. Because much of the basin is included within the Coastal Zone Boundary, Louisiana Department of Natural Resources – Coastal Management Division will be working with LDEQ and LPBF on implementation of management measures required through the Coastal Nonpoint Source Pollution Control Program (LDEQ 2010c).

## 7.4 Stormwater Permitting Requirements and Presumptive Best Management Practices Approach

### 7.4.1 Background

The NPDES permitting program for stormwater discharges was established under the Clean Water Act as the result of a 1987 amendment. The Act specifies the level of control to be incorporated into the NPDES stormwater permitting program depending on the source (industrial versus municipal stormwater). These programs contain specific requirements for the regulated communities/facilities to establish a comprehensive stormwater management program (SWMP) or stormwater pollution prevention plan (SWPPP) to implement any requirements of the TMDL allocation (see 40 CFR Part 130).

Stormwater discharges are highly variable both in terms of flow and pollutant concentration, and the relationships between discharges and water quality can be complex. For municipal stormwater discharges in particular, the use of system-wide permits and a variety of jurisdiction-wide BMPs, including educational and programmatic BMPs, does not easily lend itself to the existing methodologies for deriving numeric water quality-based effluent limitations. These methodologies were designed primarily for process wastewater discharges, which occur at predictable rates with predictable pollutant loadings under low-flow conditions in receiving waters. EPA has recognized such problems and developed permitting guidance for stormwater permits (USEPA 1996).

Because of the nature of stormwater discharges, and the typical lack of information on which to base numeric water quality-based effluent limitations (expressed as concentration and mass), EPA recommends an interim permitting approach for NPDES stormwater permits that is based on BMPs. EPA permitting guidance states that, "[t]he interim permitting approach uses BMPs in first-round storm water permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards" (USEPA 1996).

A monitoring component is also included in the recommended BMP approach. According to EPA permitting guidance, "each storm water permit should include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate conditions or limitations for subsequent permits" (USEPA 1996). This approach was further elaborated in a guidance memo issued in 2002. "The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and nonstructural BMPs) that address stormwater discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. … If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this" (Wayland and Hanlon 2002). This BMP-based approach to stormwater sources in TMDLs is also recognized and described in the most recent EPA guidance (USEPA 2008).

This TMDL adopts the EPA-recommended approach and relies on appropriate BMPs for implementation. No numeric effluent limitations are required or anticipated for municipal stormwater discharge permits.

### 7.4.2 Specific SWMP/SWPPP Requirements

As discussed in the Louisiana Small MS4 NPDES permit, if a TMDL assigns an individual WLA specifically to a MS4's stormwater discharge, LDEQ's permit specifies that the WLA must be included as a measurable goal for the SWMP.

Examples of activities that the MS4 may conduct to be consistent with the WLA include:

- Monitoring to evaluate program compliance, the appropriateness of identified BMPs, and progress toward achieving identified measurable goals
- Development of a schedule for implementation of additional controls and/or BMPs, if necessary, on the basis of monitoring results, to ensure compliance with applicable TMDLs

# 8. Public Participation

Federal regulations require EPA to notify the public and seek comments concerning the TMDLs it prepares. These TMDLs were developed under contract to EPA, and EPA held a public review period seeking comments, information, and data from the public and any other interested parties. The notice for the public review period is anticipated to be published in the *Federal Register* around December X, 2011, and the review period closing around January X, 2012. Any comments will be reviewed, and these TMDLs may be revised if appropriate. All comments and EPA responses will be included in an appendix to the final TMDL document.

EPA will submit the final TMDL to LDEQ for implementation and incorporation into LDEQ's current water quality management plan.

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